Europäisches Patentamt
European Patent Office
Office européen des brevets

Bescheinigung Certificate Attestation

Die angehefteten Unterlagen stimmen mit der ursprünglich eingereichten Fassung der auf dem nächsten Blatt bezeichneten europäischen Patentanmeldung überein.

The attached documents are exact copies of the European patent application described on the following page, as originally filed.

Les documents fixés à cette attestation sont conformes à la version initialement déposée de la demande de brevet européen spécifiée à la page suivante.

Patentanmeldung Nr. Patent application No. Demande de brevet n°

02079055.6

Der Präsident des Europäischen Patentamts;
Im Auftrag

For the President of the European Patent Office

Le Président de l'Office européen des brevets
p.o.

R C van Dijk

Anmeldung Nr:
Application no.: 02079055.6
Demande no:

Anmeldetag:
Date of filing: 26.09.02
Date de dépôt:

Anmelder/Applicant(s)/Demandeur(s):

Koninklijke Philips Electronics N.V.
Groenewoudseweg 1
5621 BA Eindhoven
PAYS-BAS

Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Lavered compression format for optical dics to allow multiple stream read-out

In Anspruch genommene Priorität(en) / Priority(ies) claimed /Priorité(s) revendiquée(s)
Staat/Tag/Aktenzeichen/State/Date/File no./Pays/Date/Numéro de dépôt:

Internationale Patentklassifikation/International Patent Classification/
Classification internationale des brevets:

G11B20/00

Am Anmeldetag benannte Vertragstaaten/Contracting states designated at date of filing/Etats contractants désignées lors du dépôt:

AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR

Layered compression format for optical discs to allow multiple stream read-out

General

The invention relates to storage media of with limited read-out bandwidth. Specifically, it relates to optical storage media of which the minimally guaranteed read-out bandwidth of play-back equipment as specified in the standard is limited. More specifically, it relates to Blue-ray Disc (BD) ROM of which the maximum play-back data-rate (1x) will possibly be fixed at 35 Mbit/s, to sustain playback of HDTV movie material at a bitrate of 24 Mbit/s.

Problem/invention

In various use models, there is a need to read simultaneously multiple streams from the medium, for instance for:

- Picture in picture: application in which a second stream is shown in a small window. This can be for instance the same scene shot from a different angle, or a video of the director, giving his comments
- Split screen application: 2 or 4 streams are shown simultaneously on the screen, e.g. one stream is "the making of", or multiple angles show from the same scene
- Overlays: an interactive application is overlaid on the primary movie stream, in which the interactive application uses a second stream from the disc

In BD-ROM, the video stream, which is of High definition quality, can have a bitrate of up to 24 Mbit/s. The supported maximum read-out datarate of the system as defined in the spec had not been fixed yet, but is expected to be chosen at 35 Mbit/s (1x). The reasons for such a relatively low number are cost (cheaper components) and power considerations for the portable models. Obviously, at this maximum datarate, simultaneous readout of more than 1 stream cannot be supported.
The margin of 35 Mbit/s over 24 Mbit/s will even be only sufficient to support limited interactive applications. More sophisticated interactive applications, when they ask for frequent access to the disc, may already require more headroom than is offered by this margin.
In figure 2 an embodiment of the disc according to the invention is depicted.

Solution

The invention is to choose a layered compression format for the video signal on the disc

An embodiment of the layered compression format is shown in figure 1.
Fig. 1 illustrates a layered encoding system that separates a high-resolution source image into a base layer and an enhancement layer, and stores the base layer and the enhancement layer in separate tracks on a storage medium, such as a DVD. A layered encoding system may also be referred to as an image encoding system. A high-resolution source image 100 is captured using a video camera or other device capable of capturing

an image. A series of successive source images are captured to generate a video program (e.g., a television program or a movie).

The high-resolution source image 100 is communicated to an enhancement layer generator 102 and a base layer generator 104. The enhancement layer generator 102 generates an enhancement layer portion of the source image 100 and communicates the enhancement layer to a compressor 106. The enhancement layer generator 102 generates the enhancement layer by comparing the base layer data (received from the base layer generator 104) to the high-resolution source image data. For example, the enhancement layer generator 102 subtracts the base layer data from the high-resolution source image data, thereby leaving only the high-resolution portions of the image (i.e., the enhancement layer).

The base layer generator 104 generates a base layer portion of the source image 100 and communicates the base layer to a compressor 108. The compressor 106 generates a compressed version of the enhancement layer data and the compressor 108 generates a compressed version of the base layer data. In a particular embodiment of the invention, compressor 108 compresses the base layer data using the MPEG-2 (moving picture experts group) compression algorithm. Similarly, compressor 106 may compress the enhancement layer using the MPEG-2 compression algorithm. However, compressor 106 is not required to use the same compression algorithm as compressor 108. For example, compressor 106 may use a compression algorithm that utilizes three-dimensional wavelets to compress the enhancement layer information.

The compressed base layer is stored on a first data storage track 112 of storage medium 110. A data storage track is a collection of multiple sectors on a storage medium that can be read in sequence in real time. For example, a data storage track on a DVD may be a continuous series of data elements stored in a generally circular pattern that are read as the DVD rotates. Alternatively, a data storage track on a DVD may store two interleaved streams of data, such as enhancement layer data interleaved with base layer data, in multiple sectors scattered over the DVD.

The compressed enhancement layer is stored on a second data storage track 114 of storage medium 110. In this example, storage medium 110 is a DVD. The first and second data storage tracks 112 and 114 may be located on the same physical layer of the DVD or may be located on different physical layers of the DVD (a DVD can have two sides with two physical layers on each side).

Compressors 106 and 108 compress the enhancement layer and base layer data to reduce the storage space required to store the data. If the enhancement layer and/or the base layer do not require compression (i.e., the storage medium 110 has sufficient storage space without compressing the data), then compressor 106 and/or 108 can be eliminated from the system shown in FIG. 1.

As mentioned above, the DVD format supports multiple camera angles (or video angles). A viewer of the program stored on a DVD may select the default camera angle or one of several alternate camera angles. Although DVD technology supports multiple camera angles, programs are not necessarily recorded using multiple camera angles. Due to the added cost of recording a video program using multiple camera angles, many programs do not utilize the DVD tracks provided for the alternate camera angles.

The first track 112 of the DVD is the track assigned to the default camera angle. The base layer data is stored on this default camera angle track since the base layer information is

read by both standard definition and high-resolution systems. To maintain backward compatibility with existing DVD players, the base layer data is stored using the format defined in the DVD video specification. The enhancement layer data is stored on the second track 114, which is assigned to an alternate camera angle. In this situation, the alternate camera angle track does not actually store data associated with an alternate camera angle, but instead stores data associated with the high-resolution portion of the source image. The enhancement layer contains special data sequences that allow a compatible high-definition DVD player to recognize that the camera angle track contains enhancement data. Although FIG. 1 illustrates tracks 112 and 114 as two separate tracks, in one embodiment the two tracks are interleaved, or time division multiplexed, so that the two tracks can be read simultaneously. One or both of the interleaved tracks are read by de-multiplexing the interleaved data packets.

There are various options:

1. Base layer: standard definition MPEG2 (DVD quality) (max 10 Mbit/s, av 4.5 Mbit/s), enhancement layer: high definition MPEG 2 (base + enh max 24 Mbit/s)
2. Base layer: as above, enhancement layer: more advanced decoder (e.g. H264) bringing max bitrate to lower value or allowing even higher quality video (esp. for 60Hz interlaced sports as in published compilations of Olympics etc.)
3. Base layer and 1st enhancement layer as in 1, 2nd enhancement layer to provide any signal needed (esp for 60 Hz interlaced sports) above 24 Mbit/s to ensure top quality high definition video.
4. Base layer: CIF quality MPEG2 video (max bitrate 4 Mbit/s, av 1 – 2 Mbit/s), 1st and 2nd enhancement layers like layers in 1
5. More intermediate layers can be added if needed
6. All layers including base layers can be based on novel coding techniques like H264 rather than on MPEG2

Embodiments

During normal video play back of a single stream, the highest quality is viewed. When an application is started during normal play the following can happen:

1. If the application like a PIP requires access to another stream, this other stream should be read at lower quality, by only reading the base layer thereof.

2. In split screen situation, the bit-rate, and thus quality, of both (or more) streams is reduced equally.

3. In case a disc-access intensive application is being run, the bit-rate of the (one or more) video stream(s) can be adjusted dynamically, dependent on the instantaneous use of disc resources by the application

4. In case the drive supports higher bit-rates (e.g. because it is a 2x version) the bitrate of the various streams need only be reduced such that the total need of the application fits in this higher bandwidth.

5. In case video is played back to a screen with resolution equal or lower than supported by the base layer in the case of two layers, or, in the case of more than two layers, by one of the layers other than the highest resolution enhancement layer, play back only the layers delivering that resolution, thus requiring less resources such as power, spindle speed (noise factor) or other, from the system.

6. Rather than let the screen resolution determine which layer or layers to play back, the amount of resources, such as available battery power left, can determine at what resolution to play back.

It should be made sure that the data relating to the various layers of the layered stream are organized such that skipping part of the stream to gain bandwidth in the end does not result in a loss of bandwidth because of the overhead caused by the jumps. Examples of measures to avoid this are:

1. Organize data belonging to one layer in contiguous blocks, as depicted in the fig 10 and fig 11 (schematic picture of datablocks on a disc)

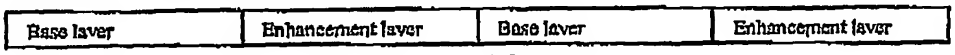

Fig. 10

The larger the blocks, the less the penalty, but at the expense of other performance as reaction speed of the system and memory buffer requirements. An optimum has to be found.

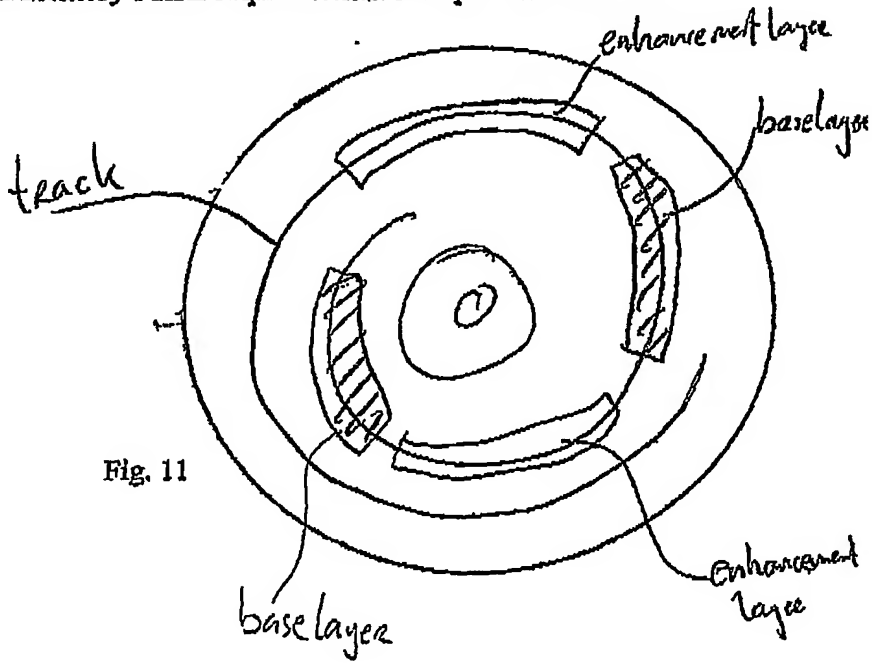

Fig. 11

2. Make sure that a contiguous block covers an integer amounts of disc rotations, plus a small slip distance, such that jumping over a block of the play-back head can be done without requiring an idle full rotation of the disc. See fig. 12.

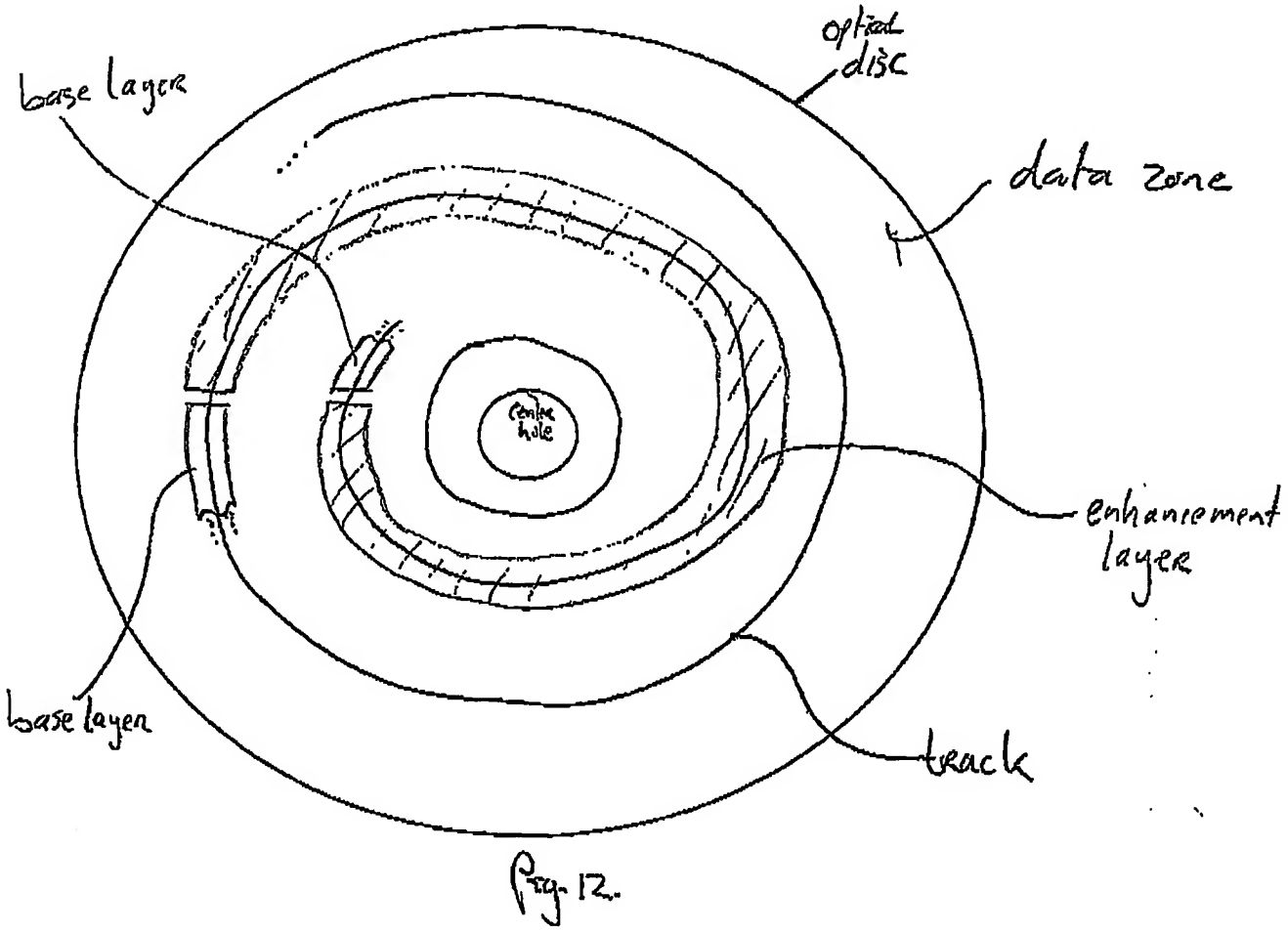

Fig. 12.

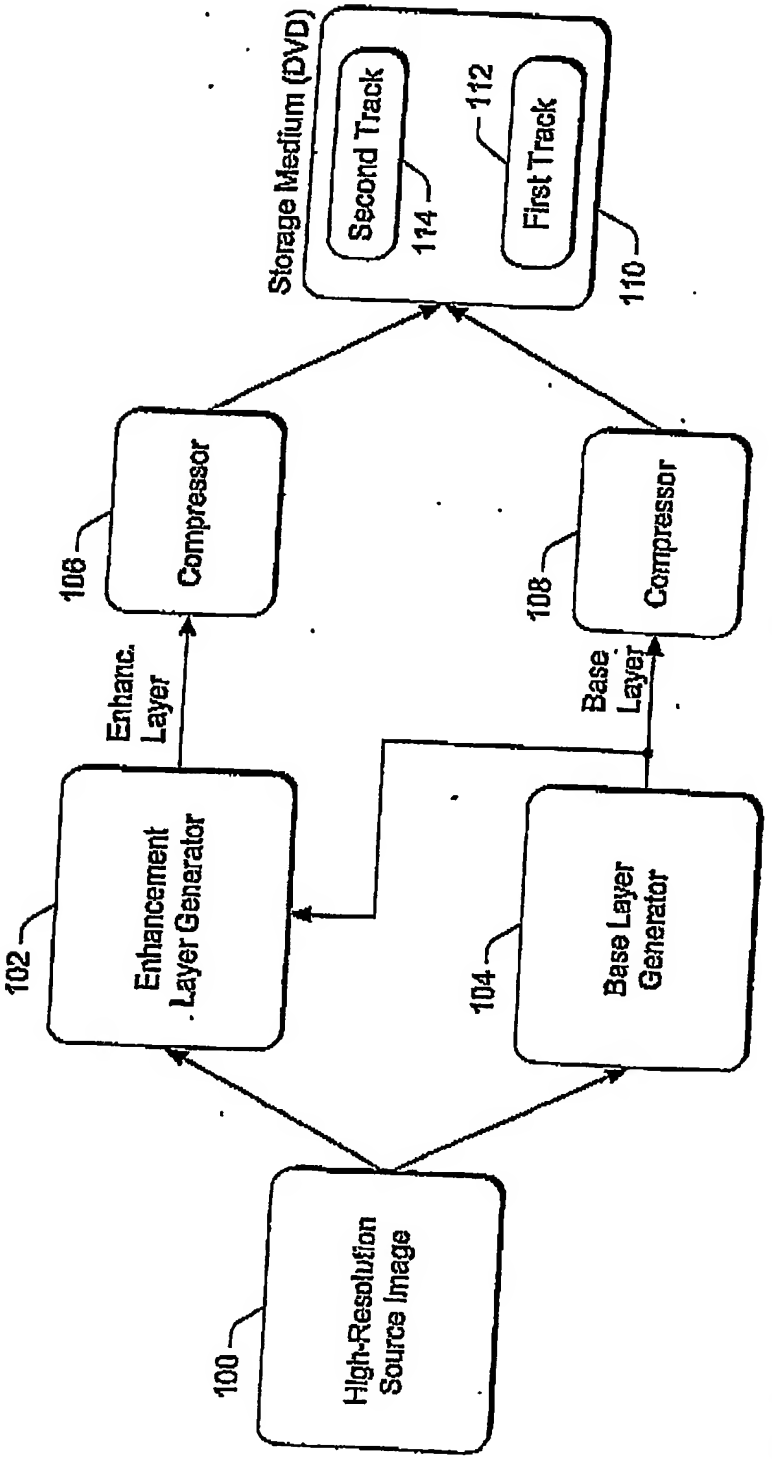
Storage Medium (DVD)
Second Track
114
112
First Track
110
Compressor
106
Compressor
108
Enhanc. Layer
Base Layer
Enhancement Layer Generator
102
Base Layer Generator
104
High-Resolution Source Image
100

Fig 1.

Layout of the disc according to the invention

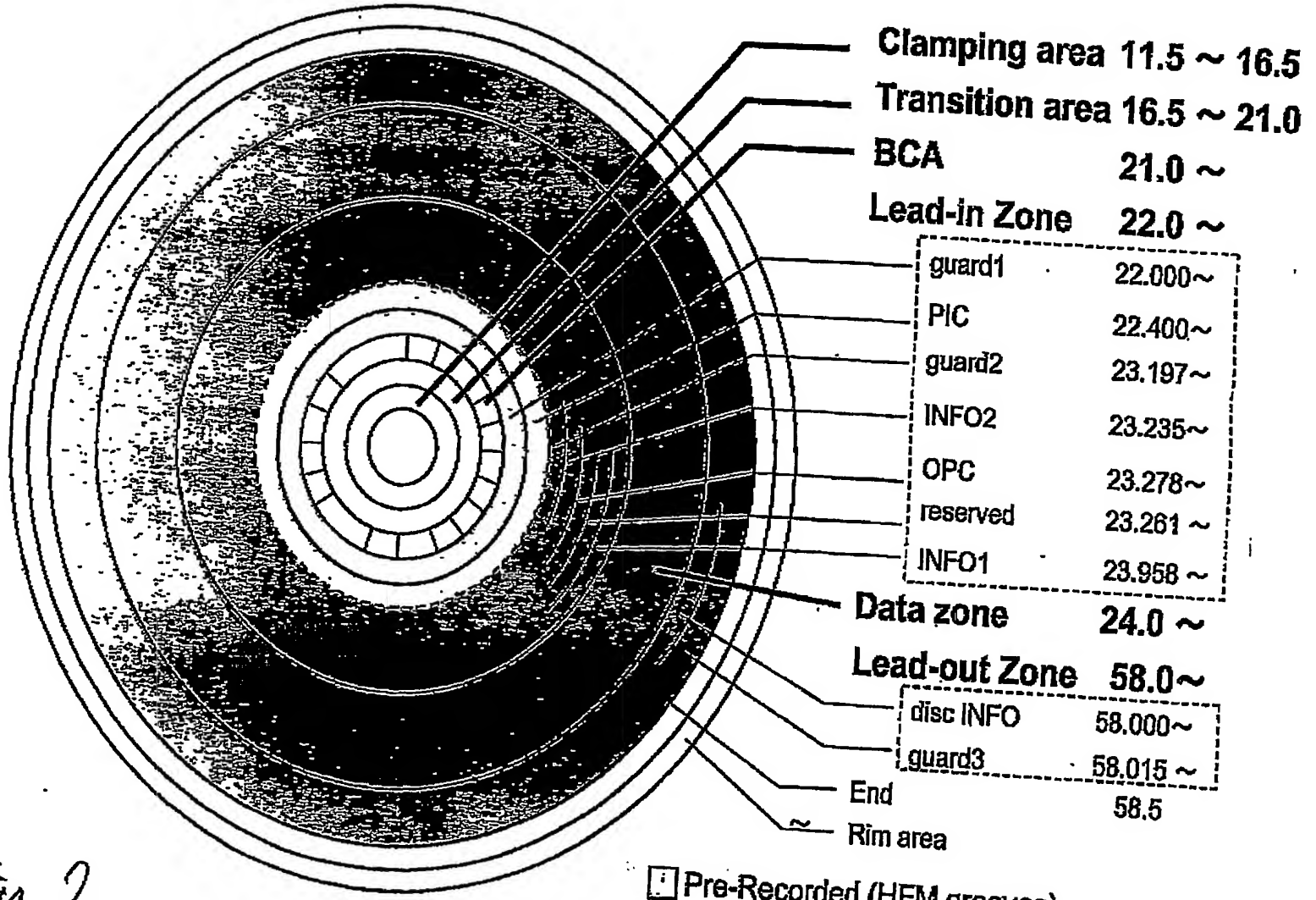

Fig 2.

CLAIMS

1. Method of encoding data for writing on a disc comprising
encoding a first layer of data representing basic data and
writing a second layer of data representing enhancement data according to the basic data.

2. Any novel feature or novel combination of features as described herein.